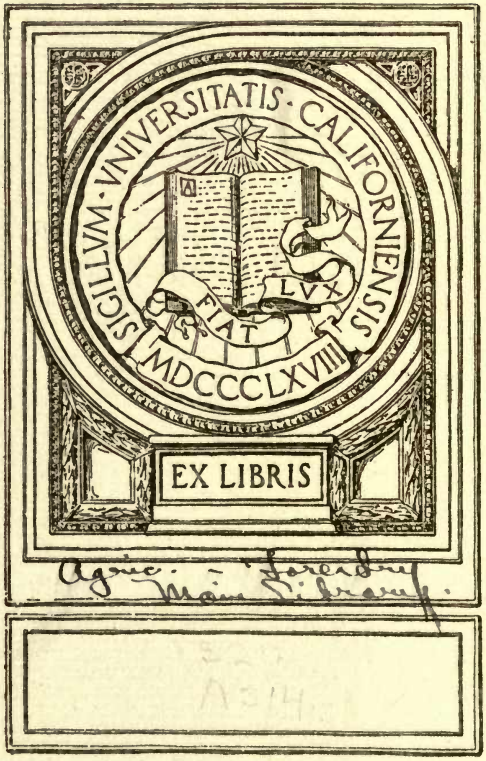
SD
373
A32

Farm Forestry


SIGILLVM · VNIVERSITATIS · CALIFORNIENSIS
LVX
FIAT
MDCCCLXVIII
EX LIBRIS

FARM FORESTRY

A TEXT BOOK

Dealing With the Wooded Parts of Southern Farms
and the Problems Growing Out of Them,
For Use in Agricultural High
Schools and Colleges

BY

ALFRED AKERMAN, A. B., M. F.

UNIV. OF CALIFORNIA

ATHENS, GEORGIA, 1914

SD 373
A32

Main Lib.
Agric. Dept.

Agric. - Forestry

CALIFORNIA
DEPT. OF

To
DAVID BARROW
and
POPE SPRATLIN
Two Farmers Who Believe in Forestry

328404

FOREWORD.

More than half of the area of farm holdings in Georgia is in woods; and more than half of the wooded area of the State is in farm holdings. The future of the forests of the State depends largely on the attitude of the farmers towards the wooded parts of their holdings. With a view to influencing their attitude, lectures on forestery were begun many years ago at the State College of Agriculture at Athens by Dr. H. C. White. These lectures were incidental to the courses in agricultural chemistry, forestry being taken up in its bearing on soil conservation. When I was elected Professor of Forestry in 1906, Dr. White turned over this work to me. The lectures have been extended into a course of three months for the One-Year students and a course of half a year for the Seniors. The following text is an outline of these courses. My chief purpose in writing it is to save a part of the time spent by the students in taking and copying lecture notes. But the problems discussed should also be of interest to those who are managing farms; and while some of them may not find all of the suggestions practicable, in the conditions existing on their farms, they will find that a part of them are practicable, and as the market and other conditions change with the industrial development of the country, they will find that more of these suggestions can be carried out.

The teachers in the District Agricultural Schools and other rural schools may find the book helpful in connection with their courses in farm management or nature study. I would remind these that the text is not intended to be exhaustive, and that it is even more important than in some other subjects to supplement the text with the teacher's own

knowledge and with as much first hand study as the students can find the time for. It has been said that one of the needs of our schools and colleges is thin text books; and if I have succeeded in nothing else, I have at least succeeded in making this one brief.

While the discussions refer to Georgia, the conditions are about the same in some of the surrounding States; and the discussions will apply to them.

Acknowledgement is made to the State College of Agriculture for the use of several photographs, and to the Board of Entomology for the revision of the notes on insects.

PART I. PRODUCTION OF TIMBER

CHAPTER I. TIMBER TREES

Section 1. Roots, Stem and Foliage.

1. For the purpose of study a tree may be divided into three parts;—roots, stem, and foliage.

2. The roots penetrate the soil and give the tree a base to stand on. They also absorb water and other substances which the tree needs in its life-processes. The absorbing surface of the roots is increased by throwing out root-hairs. These are not rootlets, but are outgrowths from the roots and rootlets. They live for a few days and then die away: others are thrown out as needed.

3. The stem and branches lift the foliage from the ground and expose it to the light and air; and it is through them that water and other substances (in solution) pass from the roots to the foliage. The stem grows in diameter and height by the addition of new wood. In most trees the old wood can be distinguished from the new; and the age of the tree can be found by counting the annual layers. The stem may be likened to a set of cones, one fitting over the other. The growth of the branches is like the stem; and as they grow outward they become larger: when they die and are broken off the wood closes over them. Branches make knots in lumber, and the kind of knots influences the quality of the lumber: they will be referred to again.

4. The foliage of a tree is its kitchen; for there is where its food is prepared. Water and other substances from the soil and carbon dioxide (C02) from the air are broken up in the leaves in the presence of light, and are made into compounds that are used by the tree in building up its

tissues. As a result of this process oxygen is freed and passes off into the air and carbon is locked up in the tree. About 49 per cent of wood, dry weight, is carbon, most of which is drawn from the carbon dioxide in the air. Its presence in the air is not apparent; and it seems a strange transformation from the invisible form to a bulky substance like wood.

5. There is another process going on in the foliage, and that is respiration. Trees, in common with animals, breathe; and as a result oxygen is taken from the air and carbon dioxide is returned to it. This process is going on night and day. The other process—the preparation of food—goes on only in the presence of light; so trees give off an excess of oxygen during the day and an excess of carbon dioxide at night.

6. A large amount of water is passed off through the foliage, especially when the air is warm and dry. The quantity of water passed in this way from the soil into the air is so great that it is doubtful whether forests in all conditions conserve the moisture in the soil as well as some other form of covering—a layer of pulverized soil, for example. There is no reasonable doubt, however, that on mountain slopes and hillsides where much of the falling water would be lost but for the obstructions which a forest cover puts in its way, that the balance is in favor of the forest.

7. The leaves are formed and placed for the work they do. They are formed so that a vast amount of foliage is carried even by a small tree; and they are arranged so as to be exposed to the air and light. Oak leaves are in spirals, so that a leaf does not cut off the light from the one that stands next below it on the twig. Ash leaves are in pairs, each on the opposite side of the twig; and the pair next be-

low is at right angles to the pair above. The branches follow the same arrangement as the leaves, and evidently for the same purpose.

8. To gain an idea of the extent of the foliage on a tree some of my students cut a shortleaf pine. It was 5.5 inches in diameter and 30.3 feet high. The crown was 14.2 feet long and 9.6 feet across. More than 45,000 needles were counted and weighed: the rest were weighed and the number calculated by proportion. The total for the tree was 195,500 needles. More than 500 needles were measured and the average length of the needles was found to be 3.33 inches. The total length of the needles was 65,101,500 inches. Placed end to end they would reach 10.27 miles. The tree had not stood in full light and had a thinner crown than many others. It is probable that the needles on five well-stocked acres of pine timber would more than reach around the world.

9. Summary;—

(a) Roots are for;—

(1) Position or anchorage,

(2) Absorption.

(b) Stem and branches are for;—

(1) Elevation and exposure of foliage,

(2) Communication between roots and foliage.

(c) Foliage is for;—

(1) Preparation of food,

(2) Respiration,

(3) Transpiration.

SECTION 2. Notes on Important Trees

10. The forest flora of Georgia is rich. The State embraces parts of the Southern Appalachian mountains, the Piedmont Plateau, and the Coastal Plain; and there are wide variations of soil and climate. There are new soils fresh from the decay of the rocks, and there are old soils that have been modified by many agencies. The harsh climate of the north slopes of the Appalachians is very different from that of the Coastal Plain. These variations in the soil and climate have given rise to a variety in the trees. About one-fourth of the species of the United States are found in the forests of Georgia.

11. The importance of a tree to the farm owner does not depend wholly on its adaptability to farm uses. Its abundance and general usefulness should also be taken into account. Several have been included in the following list which have no special usefulness on the farm; but they deserve consideration on account of their abundance or their value on the general market.

12. A convenient way of indicating the distribution of trees is by referring them to the three larger physiographic features of the State;—Mountains, Piedmont, and Coastal Plain. The change from one of these regions to another is not always abrupt; but the differences in the forest flora are distinct enough to indicate the part of the State in which a tree is found.

13. There is much confusion in the common names for trees. In studying them with a class, the members of which come from different parts of the State, a standard set of names is necessary. The names, both common and botanic,

given below are taken from Sudworth's Checklist. The botanic names are given only for reference.

14. The weights are from several sources. They are given for dry wood. Air-seasoned wood is about 15 per cent heavier than dry wood; and green wood is often twice as heavy.

15. The following notes should be used in connection with a study in the woods of bark, leaf, branching, bud, flower, fruit, and seed. It was thought best not to give full descriptions, the aim being to stress the things that are most striking to the observer, and therefore of most use in identification.

16. The local uses of the different kinds of wood should also be studied.

(a) **The Conifers**

17. Longleaf pine, PINUS PALUSTRIS.—The needles are from 8 to 18 inches long, 3 in a cluster, in dense tufts at the ends of the branches. The cones are from 6 to 10 inches long and slightly curved. The seeds are about half an inch long; they are provided with papery wings which help scatter them away from the trees that bear them.

18. The wood weighs about 39 pounds to the cubic foot. It is hard, tough, and durable in contact with the soil. It is used for many purposes, from pig-pens to interior finish. This and the Cuban pine are the chief sources of naval stores.

19. It occurs in the Coastal Plain, in some places extending scatteringly into the Piedmont Plateau. In the western part of the State it extends even into the Mountains.

20. Cuban pine, PINUS HETEROPHYLLA.—This is sometimes called slash pine. The needles are from 8 to 12 inches

long; and they occur 2 and 3 in a cluster. The cones are from 3 to 6 inches long.

21. The wood is similar to that of longleaf pine, and it is not distinguished from it on the market. It weighs about 40 pounds to the cubic foot.

22. It occurs in the Coastal Plain; but it does not extend as far inland as the longleaf. It grows more rapidly than the longleaf; and it has a better flow of resin; and where it is practicable to make a choice between the two it should be favored. The ways in which a tree may be favored will be discussed further on, in connection with reproduction and thinning.

23. Loblolly pine, PINUS TAEDA.—The needles are 6 to 9 inches long, occurring 3 in a cluster. The cones are from 3 to 5 inches long: they are closely attached to the stem.

24. The wood is lighter in weight than the longleaf, Cuban, and shortleaf pines, running about 32 pounds to the cubic foot. Its coarse grain tends to unfit it for finishing. It does not last long in contact with the soil, and this unfits it for posts. But it does as well as the other pines for sleepers, studding and rafters; and it costs less. Its lack of durability in contact with the soil may be overcome by treating it with creosote which the porous wood readily absorbs.

25. It occurs in the Coastal Plain and the Piedmont Plateau. It reproduces abundantly and grows rapidly. It often comes up in dense stands in abandoned fields, and for this reason it is sometimes called Old Field Pine. On account of its rapid growth and ability to absorb preservatives it is destined to play an important role in the forestry of the Piedmont Plateau. Where it competes with the shortleaf, and there is a choice, the loblolly should be favored.

Fig I. Old pine timber was cut away. Seed was scattered from adjoining woods Par. 117

26. Shortleaf pine, PINUS ECHINATA.—The needles are from 3 to 5 inches long; they occur 2 and 3 in a cluster. The cones are 1 and a half to 2 and a half inches long, and occur on short stalks.

27. The wood weighs about 35 pounds to the cubic foot. Like the longleaf, it is used for many purposes, although for most purposes it is inferior to it.

28. The shortleaf occurs in all parts of the State.

29. The pines have long, straight stems that are adapted to sawing into lumber. Their wood is easily worked with saw, plane, and chisel. It has considerable strength, and in most cases a pleasing grain. Its weight is less than most of the hardwoods, and this lessens the cost of handling it. The combination of good qualities found in the pines make them the most useful of all timber trees. The four spoken of above are the most important in Georgia; but six others occur in the State, and some of them have local importance.

30. Bald cypress, TAXODIUM DISTICHUM.—The leaves are from one-half to three-fourths of an inch long, and occur in two ranks along the slender branches. There is a form with foliage appressed to the branches; but the other form is the more common. Unlike most of the conifers, to which family it belongs, the cypress sheds its foliage in winter, which gives the tree a bald appearance, hence the name Bald Cypress. Although classed with the cone-bearers, the resemblance of the fruits to cones is not apparent unless examined closely; they are about one inch through and nearly round.

31. The wood weighs 29 pounds to the cubic foot. It is easily worked; and it lasts well in contact with the soil.

It is used for ties, posts, poles, water tanks, tubs, and shingles.

32. The cypress occurs along rivers and in swamps in the Coastal Plain. It has been said that the cypress is not reproducing itself, and that it will disappear when the present stands are cut. This statement, like many others that are made about the reproduction of trees, is not borne out by the facts. All through its range there are seedlings and saplings in abundance wherever the fires have not run through the swamps and bays during dry weather and destroyed the reproduction.

33. Red juniper, JUNIPERUS VIRGINIANA.—The leaves are bluish-green, about a sixteenth of an inch long, and usually appressed to the twigs. The fruit resembles a berry; it is pale green at first and dark bluish-green at maturity, from one-fourth to one-third of an inch in diameter. The bark is dark brown, tinged with red; and it separates into stringy scales. The heartwood is dull red, the sapwood nearly white.

34. The wood weighs 31 pounds to the cubic foot. It works easily, and it is durable in contact with the ground. It makes good posts, poles, and bridge sills. It is excellent for chests and closets; for the odor of the wood tends to keep away moths

35. It occurs throughout the State, preferring limestone formations, but growing on a variety of soils. In many parts of the State it is known under the name of Red Cedar.

(b) **Broadleaf Trees**

36. Black walnut, JUGLANS NIGRA.—The leaves are compound, from 12 to 24 inches long, with 15 to 23 lance-

shaped leaflets. The fruits are borne singly or in pairs; they are roundish, and yellow-green in color, turning black after they are dropped. The winter buds are covered with a buff colored nap; the lateral ones are often superposed, two or three in the axil of the leaf. Twigs when broken give out a characteristic odor, which helps in identifying the tree. The bark is dark brown and divided into ridges.

37. The wood weighs about 38 pounds to the cubic foot. It is a rich, dark brown; it has a pleasing grain; it works easily; and it takes a high polish. These qualities fit it for furniture and interior finish. It brings the highest prices of any of the North American woods. The nuts are used for food.

38. The black walnut occurs on bottoms and rich hillsides throughout the state. It grows rapidly. Since knots and burls are not regarded as a defect in walnut, it may be grown in open places where it branches profusely and still produce valuable timber. It is therefore recommended as a shade tree for yards, roadways, and pastures.

39. Mockernut, HICORIA ALBA.—The leaves are compound, 8 to 12 inches long, with 5 to 7 lance-shaped leaflets. The midribs are covered with brown hairs. The foliage is fragrant. The fruit is one and a fourth to 2 inches long. The nut has 4 prominent ridges; it has thick walls and a small kernel.

40. The wood weighs about 53 pounds to the cubic foot. It is hard, strong, and tough; and these qualities fit it for spokes, axle trees, ax handles, whip-staffs, and the like. It makes excellent fuel.

41. The mockernut occurs throughout the State.

42. There are several other hickories in Georgia.

Among them may be mentioned the pignut, the bitternut, the shagbark, and the shellbark.

43. The pecan is also a hickory. It is not a native of Georgia; but it has been introduced on a large scale on account of of its nuts. It is inferior to many of the hickories as a timber tree.

44. Black willow, SALIX NIGRA.—The leaves are lance-shaped, about 4 inches long and half an inch wide, with fine teeth along the margins. The flowers are in catkins, about 2 inches long.

45. The wood weighs about 28 pounds to the cubic foot. It is easily worked, but is not strong or durable. Willow rods are used to make baskets, wicker ware, and rustic furniture.

46. The willow occurs throughout Georgia on wet soils along water courses. It may be used, like cottonwood, to stop washing along ditches, creeks, and rivers.

47. Cottonwood, POPULUS DELTOIDEA.—The leaves are about 4 inches long and 3 inches wide, somewhat triangular in shape. The buds are about half an inch long: they contain a sweet-scented resin. The fruits are borne in catkins, and are covered with a cotton-like substance, hence the name.

48. The cottonwood weighs about 24 pounds to the cubic foot. It is soft, does not last in contact with the soil, and is apt to warp in seasoning.

49. It occurs throughout the State on the banks of streams. It grows rapidly and is easily propagated. Like the willow it may be used to prevent washing along the banks of streams.

50. Beech, FAGUS ATROPUNICEA.—The leaves suggest

those of the chestnut. They are 2 and a fourth to 5 inches long and 1 to 3 inches wide, with coarse teeth along the margins. The winter buds are one-half to an inch long, slender, dark brown and shiney. The fruit is a small burr, about three-fourths of an inch long, on a stalk of the same length. The nut is small, about the size of a chinquapin but triangular in shape.

51. Beech wood weighs about 43 pounds to the cubic foot. It is hard and strong but not durable in contact with the ground. It makes beautiful and durable flooring. It is also used for furniture. Like most of the heavy woods it makes good fuel. The mast is relished by swine, and it is said to impart an excellent flavor to the meat.

52. Beech occurs scatteringly all over Georgia, usually on rich moist slopes or bottom lands. It endures partial shade; and when forestry is developed to the extent that it has been developed in other countries, this ability to endure shade may be used to grow a crop of beech under stands of thin-topped kinds that do not cast a dense shade.

53. Chestnut, CASTANEA DENTATA.—The leaves are oblong lance-shaped, with coarse teeth, corresponding to the ends of the veins. They are 6 to 9 inches long and 2 to 3 inches wide. The male flowers are in catkins, 6 to 8 inches long when grown. The fruit is a spiney burr.

54. Chestnut wood weighs about 28 pounds to the cubic foot. It is easily split. It lasts well in contact with the ground. It is used for posts, vine-yard stakes, and bridge sills. The durability of the wood in contact with the ground is due to the presence of tannic acid. The extraction of acid from chestnut for tanning purposes has become a considerable industry in recent years.

55. The nuts are superior in flavor to the foreign chestnuts, although they are smaller. Some of the mountain farmers make a practice of gathering chestnuts to be sold in Athens, Gainesville, Atlanta, and other Middle Georgia cities, where they bring about $3 a bushel.

56. The chestnut occurs abundantly in the Mountains and scatteringly in the Piedmont. It is said that in former times it was more abundant in the Piedmont than at present; and its decrease has been explained by insect and fungous attacks. It is probable that the importance of insect and fungous attacks has been over-stressed. The insects and fungi have no doubt done their part of the destructive work; but they are not the only agents at work. The wood is in demand, even in small sizes; and this has led to severe cutting. The nuts are eaten by men and other animals; this hinders a plentiful reproduction. It is not fire-resistant. When all of these things are considered, there is no wonder that the chestnut is not so abundant as it was.

57. In the New England and Middle States a fungous disease known as the chestnut bark disease, has done great harm to the chestnut forests for the last few years. It is to be hoped that it will run its course before it reaches the South. It is unwise, however, to take alarm at an outbreak of one of these diseases, except to observe such precautions as one may to prevent an outbreak or to curb its spread. By referring to the chapters on caring for the stand it will be seen that the preventive measures are simple and consist mostly in keeping out fires and in thinning the stands at intervals to keep them in a healthy, thrifty, resistant condition.

58. White oak, QUERCUS ALBA.—The leaves are deeply

Fig. II. Fire in turpentine orchard. Par. 149

divided into rounded lobes. They are green above and pale on the under surface. The acorns are chestnut brown, about a fourth of an inch long, enclosed by a cup for about a fourth of their length. The bark is a light grey, and broken into scales.

59. White oak weighs about 50 pounds to the cubic foot. It is strong, tough, and durable; and it has a pleasing grain. It is used for ties, posts, wagon tongues, spokes, cotton baskets, fuel, furniture, and interior finish. The white oak is one of the best all-round farm timbers; and in spite of its slow growth it deserves favorable consideration.

60. The white oak occurs throughout the State.

61. There are several oaks in Georgia which are closely related to the white oak. Among them may be mentioned the post oak, the cow oak, the chestnut oak, and the live oak. The oaks that belong to the white oak group usually have lighter-colored bark than the black oaks, no bristle points on their leaf lobes, and mature their acorns in one season. The wood is tougher and lasts longer in contact with the ground than the black oaks.

62. Red oak, QUERCUS RUBRA.—The leaves are divided into pointed lobes. The acorns are broad at the base, three-fourths to 1 and a fourth inches long, one-half to 1 inch wide, borne in a shallow cup. The bark breaks into long ridges that sometimes suggest chestnut bark.

63. The wood weighs about 46 pounds to the cubic foot. It is brittle as compared with white oak, and it is not so durable in contact with the ground. It is used for furniture, interior finish, and firewood.

64. The red oak occurs in the Mountains and the Piedmont.

65. The red oak is taken as an illustration of the blac oak group. Of the others belonging to this group the Span ish, scarlet, yellow, water, and willow oaks may be mention ed. The black oaks have dark bark, bristle points on th lobes of their leaves, and take two years to mature thei acorns. For use about the farm the black oaks are inferio to the white oaks.

66. Red mulberry, MORUS RUBRA.—The leaves ar ovate, pointed at the apex and heart shaped at the base coarsely serrate, 3 to 5 inches long and 2 and a half to inches broad, dark green above and lighter green on the un der surface; sometimes lobed. The winter buds are ovate about a fourth of an inch long, with chestnut-brown scales The fruit when ripe is black, sweet, and juicy, and about and a quarter inches long. When the bark is broken a milky juice appears; and this with the peculiar smell of the broker bark, aids in its identification.

67. The wood weighs about 37 pounds to the cubic foot. It is durable in contact with the ground, and is used fo fence posts.

68. The red mulberry occurs scatteringly on good soils throughout the State.

69. Tulip-tree, LIRIODENDRON TULIPIFERA.—The flow er resembles a tulip. The winter buds are about half an inch long, with dark red, leathery coverings. The tendency to form a clean, central shaft is stronger in this tree than in many of the broadleaf trees. This aids in distinguishing it in the woods; and it increases its value as a timber tree.

70. The wood weighs about 26 pounds to the cubic foot. The heart is light yellow, often tinged with green; the sap wood is creamy white. On exposure to the air the wood

takes on a brownish hue. It is easily worked. It is used for boxes, wagon bodies, and interior finish. It does not last in contact with the ground; but it makes a durable shingle.

71. The tulip-tree is widely distributed over the State, usually on deep, rich, moist soils. It grows rapidly and attains very large dimensions. It has been claimed for it that it is the largest tree east of the Mississippi. It is often called Yellow Poplar, probably with reference to the color of the wood.

72. Sweet gum, LIQUIDAMBAR STYRACIFLUA.—The leaves are palmately lobed, light green in summer, turning crimson in autumn. The branches have corky wings, resembling those of the wing elm. The seeds are borne in heads about an inch in diameter, which remain on the tree through the winter. When the bark is broken a balsam is exuded, which gives the tree the name of sweet gum.

73. The wood weighs 36 pounds to the cubic foot. It is rather hard to season and must be carefully stacked to prevent warping. It is used for wooden-ware and furniture. As other woods become scarcer the demand for sweet gum is increasing.

74, It occurs throughout the State on rich bottom lands. It is sometimes sold on the lumber yards under the name of Red Gum.

75. Sycamore, PLATANUS OCCIDENTALIS.—The outer bark sheds, leaving smooth green or white trunk and limbs. The fruits are balls, about 1 inch in diameter. The seeds are very small and are provided with tufts of hair which facilitate their distribution by the wind.

76. The wood weighs 36 pounds to the cubic foot. It

has a pleasing grain, but is rather hard to work. It is used for wooden-ware and interior finish. Like the sweet gum it is more in demand as the supply of more popular woods decreases.

77. The sycamore occurs throughout the State on deep, moist soils. It attains very large dimensions, and disputes with the tulip-tree the honor of being the largest tree in the eastern United States.

78. Black cherry, PRUNUS SEROTINA.—The leaves are oblong-lanceolate, resembling those of the peach which belongs to the same genus. The fruit is about a third of an inch in diameter, black when ripe, occurring in racemes. The bark has a bitter taste.

79. The wood weighs 36 pounds to the cubic foot. The heart wood is a beautiful reddish brown and it takes a high polish. It is used for furniture and interior finish. The fruit is used to small extent in flavoring drinks; and both the fruit and bark are used in medicinal preparations.

80. The black cherry occurs all over the state on deep, rich soils.

81. Honey locust, GLEDITSIA TRIACANTHOS.—This tree is known by its compound leaves, the leaflets of which are smaller than those of the yellow locust; by large, branched thorns; and by its dark brown fruits, 12 to 18 inches long.

82. The wood weighs 42 pounds to the cubic foot. It is hard, strong, and durable. It is used for fence posts. The fruits have some value as stock food.

83. This tree does not appear to be native anywhere in Georgia; but it has been widely introduced.

84. Yellow locust, ROBINIA PSEUDACACIA.—The leaves are compound, 8 to 14 inches long, with 15 to 21 leaflets.

The large white, sweet-scented flowers which come in May are of the familiar pea-blossom shape. The fruit is a pod 3 to 4 inches long and a half inch wide. The small branches have short curved prickles, unlike the long thorns of the honey locust.

85. The wood weighs 45 pounds to the cubic foot. It is yellowish-brown in color, hard, and durable in contact with the ground. It makes good fence posts.

86. The yellow locust appears to be native only in the Mountains; but it has been widely planted in other parts of the State. Unfortunately it is often attacked by borers when planted outside of its natural range.

87. Red maple, ACER RUBRUM.—This tree is known by its opposite branches and the reddish color of its twigs, buds, and keys.

88. The wood weighs 39 pounds to the cubic foot. It is used for wooden-ware, furniture, and fuel.

89. The red maple occurs throughout the State, commonly on wet soil along streams and in swamps.

90. The silver maple and the sugar maple also occur in the State. They are used for the same purposes as the red maple where they occur in sufficient quantities to be used.

91. Basswood, TILIA AMERICANA.—The flowers are suspended from peculiar, modified leaves. The leaves aid in the distribution of the seed.

92. The wood weighs 28 pounds to the cubic foot. It is easily worked; it has no taste or odor. These properties make it an an excellent material for wooden-ware, bee gums, boxes, and wagon bodies.

93. The range of the basswood has not been worked out. It is known to occur in the northern part of the State,

and other species of the genus occur in other parts. These other species have similar properties and uses to the one described.

94. Black gum, NYSSA SYLVATICA.—The leaves vary in shape, but are generally lance-shaped, 2 to 5 inches long, 1 to 3 inches wide, dark green, turning crimson in autumn. The fruits occur 1 to 3 in a cluster: they are about half an inch long, dark blue; the clusters are on stalks about 1 inch long.

95. The wood weighs 40 pounds to the cubic foot. It does not splinter and for this reason makes a good floor for a warehouse, storeroom, or barn where it is subjected to rough usage. It also makes good rollers for moving heavy objects.

96. The black gum and related species are found throughout the State, commonly on moist or wet soils, along water courses or in swamps. The fruit of one species, the Sour Tupelo or Ogeechee Lime, is used for preserves.

97. Persimmon, DIOSPYROS VIRGINIANA.—The leaves are dark green and shiney on the upper surface, paler below, 4 to 6 inches long and 2 to 3 inches wide. The fruit is from 1 to 1 and a half inches in diameter, orange colored.

98. The wood weighs 49 pounds to the cubic foot. It is hard and strong, and is used for tool handles, shuttles, and fuel. The fruits are used to a small extent for food and in making persimmon beer.

99. The persimmon occurs throughout the State. It often comes up along the edges of the woods and in fence corners.

100. White ash, FRAXINUS AMERICANA.—The leaves are compound, 8 to 12 inches long, with 5 to 7 lance-shaped leaflets. The branching habit is opposite. The seed is provided

Fig. III. An uneven-aged stand from which the larger trees should be culled. Par. 164

with a wing that aids in its distribution.

101. The wood weighs 39 pounds to the cubic foot. It is used for tool handles, wagon tongues, and furniture. For such a purpose as a wagon tongue it is superior to hickory; for it has sufficient strength, greater stiffness, and less weight. It is an excellent farm timber.

102. The white ash is found throughout the State, commonly on moist soil. The red, green, and water ashes are also found in the State. The white ash was selected to represent the genus.

103. Hardy Catalpa, CATALPA SPECIOSA.—The leaves are heart-shaped, 10 to 12 inches long and 7 to 8 inches wide, opposite or in whorles of three. The showy flowers are in panicles. The fruits are in pods, 8 to 20 inches long.

104. The wood weighs 26 pounds to the cubic foot. It is very durable in contact with the ground. Its principal use is for fence posts.

105. The hardy Catalpa is not native in Georgia; but its introduction on a large scale is often advocated. It is claimed for it that it is easily propagated, grows rapidly, and lasts well in contact with the ground. These claims are conceded. But on the other hand, it requires skill and care in handling to make it form straight trunks. The shoots die back from the ends each year; and the new growth is from the sides; this tends to make a crooked trunk. It requires a deep, rich, moist soil to make a rapid growth. There are small patches of ground that would grow Catalpa to advantage that are not needed for other crops; but speaking generally, the soil that is needed by Catalpa is the soil that ought to be in field crops. And there are many native trees that can be used for the same purpose, which are not as hard to care for and

which are not so exacting as to soil. When these things are taken into consideration, it would seem the part of wisdom to be cautious about introducing Catalpa on a large scale. To plant a little as an experiment would do no harm; but to plant it as a business proposition would be a mistake.

106. The common Catalpa is native in Georgia; but it has the same defects as the Hardy Catalpa and the additional one of being a slower, smaller growth. It is used locally for fence posts.

107. Eucalypts.—The introduction of the Eucalypts from Australia is sometimes spoken of. They have been grown successfully in California, but only in those parts where there is little or no frost; and there is scarcely any chance of growing them in any part of Georgia. Even in California there is reason to believe that the rate of growth has been exaggerated; and the State and United States foresters have found it advisable to warn the public against too great expectations from Eucalyptus plantations.

108. Reference literature.—"Manual of the Trees of North America," Sargent.

"Checklist of the Forest Trees of the United States," Sudworth.

109. Topics for further study,—

(a) Formation of knots,
(b) Branching habits,
(c) Arrangement of leaves,
(d) Outlines of leaves,
(e) Identification by winter buds,
(f) Identification by bark,
(g) Identification by grain.

CHAPTER II. REPRODUCTION

110. If an oak is cut down, it sprouts again from the stump. If a willow switch falls onto moist ground it takes root and grows. If a pine seed falls on a favorable spot, it germinates and starts a new tree. These ways that trees have of reproducing themselves,—by sprouts, by cuttings, and by seed,—may be used in securing a stand, the way selected depending partly on the kind of tree and partly on the purpose for which it is to be grown.

Section 1. Sprouts

111. Of the kinds discussed in the last chapter, the walnut, hickory, willow, cottonwood, beech, chestnut, oaks, mulberry, tulip-tree, sweet gum, sycamore, cherry, locusts, maple, basswood, black gum, persimmon, ash, and Catalpa sprout from the stump; and stands of these kinds may be reproduced simply by cutting down the old stands, making the stumps as low as practicable.

112. Sprouts grow rapidly for a few years, but the growth falls off later on. They are more apt to die in the top—to form stag-heads—than trees of seedling origin; and they are more subject to decay at the base.

113. Reproduction by sprouts cannot be carried on indefinitely without a thinning out of the stand; for some of the stumps lose the power of sprouting vigorously. Unless there is a sprinkling of seedlings from time to time to take the place of the stumps that are lost, the stand deteriorates.

114. Reproduction by sprouts does well enough for some purposes, such as the production of stakes, posts, poles, and firewood; but is not recommended where a good quality of saw-timber is desired. And generally the production of

saw timber should be the aim of the owner; for plenty of stakes, posts, poles, and firewood can be gotten from limbs, tops, and thinnings. When thrifty sprout reproduction occurs it should be taken care of; but seedling reproduction should be favored where there is a chance to give it the advantage.

Section 2. Cuttings

115. The willow and cottonwood are easily propagated by cuttings, and this method is preferable for these two kinds. They are rarely wanted except to protect the banks of a ditch or stream. For this purpose make cuttings about 18 inches long and stick them in the ground along the bank in two rows, 4 feet apart and 4 feet in the row, the cuttings in the second row being opposite the spaces in the first row. One or two of the top buds should be left above the ground. A damp day in late winter is the best time for the work.

Section 3. Seed

116. The pine, cypress, and juniper do not sprout and must be reproduced by seed; and seedling reproduction of most of the kinds that do sprout is preferable. Seedling reproduction may be secured by encouraging the production of seed and giving it the proper conditions for germination and growth; or it may be secured by sowing and planting, or by a combination of the natural methods with sowing and planting.

117. The ways in which seeds are scattered is interesting. The pine seed is provided with a wing: the weight of the kernel is arranged so that the seed whirls around as it descends through the air; this delays the fall and gives the seed a chance to sail out on the wind. The ash, tulip-tree, and sweet gum have a similar device. Acorns, walnuts, and

hickories are too heavy to be carried by the wind, but their weight and shape are such that if they strike a limb in falling, they will bounce a considerable distance and roll along the ground. The birds and squirrels, although they destroy many seeds, also aid in scattering them. The design in Nature seems to be to get the seeds scattered away from the parent tree. The thoroughness with which this design is carried out is remarkable. In the fall of 1910 the tulip-tree carpels were counted on 7 plots in Clarke county. These plots were some 60 feet from a tulip-tree: but when an average was struck, it was found that the carpels ran 2,062,783 to the acre; and since each carpel contains 2 seeds, the seeds had been scattered at the rate of 4,125,566 to the acre. And even at a distance of 600 feet from a tree, they ran between 100,000 and 200,000 to the acre.

118. The thoroughness with which seeds are scattered is further illustrated by the dense stands of pine and other trees that came up in abandoned fields during and after the Civil War.

119. Here at the South the forest will nearly always maintain itself and come again when cut down, if given a chance. It is only necessary to keep the fires from burning up the seeds and killing the seedlings. The problem of reproduction by seed resolves itself into the problem of protection from fire.

120. It may happen, however, that natural seeding is deficient on small areas or that the owner wants a particular kind of tree. In such cases sowing or planting must be resorted to.

121. When artificial reproduction must be used, it is better to sow the longleaf and Cuban pines, walnut, hickory,

oaks, and locust in seed-spots where they are to grow than to start them in a seed-bed and transplant them later on. These kinds tend to form a long tap-root which renders their removal from the seed-bed to the permanent site laborious and expensive. It is, therefore, better to sow them in seed-spots.

122. Seed-spots are made by working the soil lightly with a hoe or mattock over a spot about a foot across. The seeds are sown 3 to 4 to the spot and covered about twice their depth. The spots should be about 6 feet apart each way. A convenient way to secure uniformity is to set tall stakes as guides for the rows, moving them at each turn across the patch. The distance in the row may be paced. On slopes the distance in the row may be shortened to 4 feet, and the distance between rows may be increased to 9 feet, the rows following around the slope like cotton rows in a terraced field. This method affords more of a barrier to washing, and it gives the same amount of space, 36 square feet to each tree.

123. The best season to sow seed-spots is in the fall. This does away with the trouble of keeping the seeds over winter. Fail spots should be reseeded the following fall.

124 Sowing in seed-spots costs very little. The labor of preparing the spots and sowing should not exceed $1.50 an acre. A good hand can prepare and sow from three-fourths to an acre a day. The cost of the seeds depends on the kind, but it is generally small. For instance, a pound of yellow locust seed may be bought for 40 cents, and it will sow 5 acres.

125. Such trees as the shortleaf and loblolly pines, the beech, chestnut, tulip-tree, basswood, ash, and Catalpa may

Fig. IV. Reproduction in an opening made by removal of mature trees. Par. 164

be sown in seed-spots, but the surer way is to sow them in a seed-bed and transfer them to the permanent site as seedlings of one or two year's growth. A seed-bed may be made in any light, mellow soil, such as a vegetable garden. The soil should be thoroughly worked, as for vegetables. The seeds should be sown in drills, some 2 or 3 feet apart, and lacking the thickness of a seed of touching in the drill. They should be covered to twice their depth.

126. As in sowing seed-spots, the trouble of keeping the seed over winter is avoided, if the sowing is done in the fall; and the germination is usually better for seeds sown in the fall than in the spring.

127. The seed-bed should be kept mellow and free from weeds. Light working with a plow or hoe, followed by pulverizing with a rake is the best cultivation. Baking and drying should be prevented, and lath screens are often used for this purpose; but they are an additional expense and they interfere with working the beds. The experience of the writer has led him to abandon the screens and rely wholly on pulverizing with a rake, or the "dust mulch" as it is called, to keep the moisture near the surface.

128. In seasons of drouth it may be advisable to irrigate. If this is done, the ground should be thoroughly wet; and it should be worked when dry enough, as after a rain. A thorough wetting followed by a working will do good; but frequent sprinklings may do more harm than good.

129. The length of time that the seedlings remain in the seed-bed depends on their rate of growth. Some of them like the tulip-tree, are large enough to move in one year; but others, like the shortleaf pine, require two years to reach a convenient size.

130. The roots of seedlings should not be allowed to dry out in moving them from the seed-bed to the permanent site. To prevent drying the roots should be dipped in a puddle immediately upon being taken from the ground. A puddle is made by stirring soil into a tub until a thin mud is formed. The puddle should be stirred again before each bundle of seedlings is dipped. When the seedlings are puddled they are placed in a bucket or basket and covered with a damp cloth or some damp leaves. They are then ready to be taken to the permanent site.

131. When a hole of convenient size has been opened with a mattock, a plant is taken from the basket and held in place with one hand while the soil is drawn about the roots with the other. Care should be taken not to get any sod or leaves next the roots. When the soil has been drawn about the roots, it is firmly packed with the heel, to get it in close contact with the roots. The soil is settled against the roots of fruit, shade, and ornamental trees by the use of water; but in forest planting the use of water is impractical, and packing with the heel is used instead.

132. As in making seed-spots, the planting may be made uniform by using stakes to guide on. The distance recommended is also the same, 6 by 6 feet, or 4 by 9.

133. Seedlings may be removed from the seed-bed from November to April. February is the best time; for they are then not exposed to the severe cold of winter and they have time to become adjusted to their new surroundings before the hot, dry weather sets in.

134. Topics for further study.—

(a) Effect of high stumps on sprouting.

(b) Age to which sprouting power is retained.

(c) Relative sprouting power of different kinds,

(d) Nature's methods of dissemination,

(e) Germination percentages,

(f) Effect of forest fires on seeds,

(g) Effect of forest fires on seedlings.

CHAPTER III. PROTECTION

135. Stands of trees have enemies. Among these are fungi, insects, and fires.

Section 1. Fungi

136. Sometimes low forms of plant life, called fungi, grow on the inside of trees and feed on their wood, causing decay. Unless these plants bear fruit we may not know of their presence. Their fruiting bodies are sometimes called toad stools or frog stools. One common form is small at the top and grows larger from year to year by the addition of a layer at the bottom. If the under side of one of these is examined it will he found to be full of small holes, from which the spores of the fungus are discharged. The spores are blown about in the air; and if one finds lodgment in a knot-hole or other place where the bark is broken, it may develop and grow into the tree. Fungi may also spread through the ground by filaments from an infested tree reaching the roots or butt of another tree.

137. Little may be done towards protecting a stand from fungous diseases; because in our present stage of development the timber crop is not valuable enough to allow the expenditure that an active campaign against fungi would involve. The most that may be done is to keep the timber in a thrifty, healthy condition by the prevention of fires and the removal of diseased trees.

Section 2. Insects

138. The wood, inner bark, and the foliage of trees are attacked by insects. The small, shot-like holes sometimes seen in red oak wood are the result of insect attack on the wood; they are the passages out by an insect, and they de-

tract from the usefulness of the wood.

139. The pine bark beetle is an example of the insects that actack the inner bark. It makes galleries in the inner bark, which may girdle the tree and cause its death. In the adult stage this insect is about three-eights of an inch long; it is brown in color, sometimes nearly black. It can fly for some distance, and spreads from place to place in this way. Summer cutting in pine woods should be avoided as far as practicable, because the odor of the resin attracts the beetles to the neighborhood and often starts an outbreak that it is hard to check. Sometimes a tree is struck by lightning, the beetles are attracted to it, and they spread to surrounding trees. Its spread may be controlled by cutting and removing the trees while the insects are in them. Their presence is shown by the fading of the foliage. To do any good they must be removed before the beetles are gone, that is before the foliage has turned brown. The infested trees should be cut during December, January, and February. If the trees are large enough for saw-logs, they should be sawed at once, or be barked at once to expose the insects. If they are used as firewood, they should be used before the spring weather comes on, or some of the insects may escape. The larger limbs, if not used as firewood, and the smaller brush should be piled around the stumps and burned.

140. The insects that prey on the foliage are also injurious. If the foliage of pine trees is destroyed, they will die. The broad-leaf trees are hardier; and they will stand two or three defoliations before they succumb. But a lesening of the foliage, although it may not result in the death of the tree, retards its growth, lowers its vitality, and lessens its resistance to future insect or fungous attacks.

141. Aside from the measures which may be taken to prevent the spread of the pine bark beetle, there is little that the owner can do to combat the attacks of insects. He can, however, do something by way of prevention. If the stands are kept in a thrifty, healthy condition, they are less liable to attack than if allowed to become unthrifty; and the removal of tops, dead, and dying trees, if practicable, is recommended, for they furnish a breeding ground for insects.

Section 3. Fires

142. Fire is the worst enemy of the forest. It destroys the seeds that are lying in the litter ready to germinate. It kills the seedlings and saplings that would form future stands. It sometimes kills the larger trees; or if it does not kill, it injures them; the roots that are near the surface are scorched; and the bark is killed in patches about the bases of the trees. Even when these patches are healed over they leave bad places in the lumber that lower its quality and value. Often several feet of the bottom logs in burned woods must be cut off and thrown away because of old fire scars.

143. The litter and humus are burned up and the soil is impoverished. This retards the growth of the trees, and it lowers their vitality, so that they are more liable to the attacks of fungi and insects.

144. Forest fires are sometimes followed by an increased proportion of scrub oak, sumuch, and other inferior or worthless trees; and it may take years for the more useful trees to crowd out this undesirable growth.

145. Some farmers say that they cannot protect their woodlands from fire. Speaking generally, these are the ones that have not tried. Woods can be protected from fire.

Fig. V. An even-aged mature stand which should be cut clear. Par. 165

The protection cannot be made absolute, just as the protection of town property is not absolute. In spite of the most stringent building regulations and trained fire departments, fires continue to occur in town. But the risk to town property has been reduced to a very small quantity; in some cases it is calculated to be less than three chances out of a thousand. In places where an effort has been made to protect woods from fire, it has been found that the risk can be reduced to a smaller quantity than in the case of town property; in some cases it is calculated to be less than one chance in a thousand.

146. The protection of farm woodlands from fire is a simple matter. It is a common practice when working in the woods in cold weather to build a fire to warm the hands and feet by. The fire should be placed where it will not spread; and it should be put out before leaving. When a field adjoining the woods is brushed out, the brush should be piled far enough away to prevent setting the woods afire when it is burned. When a field is burned off to prepare for plowing, if it adjoins the woods, a few furrows should be run between it and the woods before the fire is set. All tenants and hands on the place should be made to turn out and help fight a fire in the woods should one by any chance get started. This will tend to make them careful in handling fire.

147. Where woods join the woods or fields of a neighbor or lie along a railroad, it is a good plan to separate them by a fire line. A fire line is a strip about 20 feet wide from which the dry brush, litter, and grass have been removed. It is made by raking paths about 3 feet broad on either side of the proposed line and burning the area between the paths. The burning should be done when the wind is low and when

there is enough moisture in the woods to render easy the control of the fire. Conditions are so varying that it is hard to arrive at an average cost of making a fire line. With inexperienced hands and unfavorable conditions the cost may amount to $20 a mile; with experienced hands and favorable conditions it should not exceed $10 a mile. They should be burned off each year. There is usually a good deal of brush and a good many snags in the way of raking the paths the first time; so that the cost is less after the first burning. In the fall, when most of the leaves are down but not yet very dry, is the best time of year to burn a fire line. A fire line may not stop all fires; but it stops ordinary fires, and it checks even the most severe ones long enough to get them under control.

148. It is the practice in some parts of the State to burn off the woods to improve the pasturage. It is doubtful whether this improves the pasturage in the long run. Some farmers claim that woods that are not burned over have more grass in them; and they have quit burning them. Even granting that burning does improve the pasturage, when the injury to the woods is reckoned in, it makes an expensive improvement. The cost is hard to estimate exactly; but the indications are that it would be cheaper to seed down a piece of land to good grasses than to burn the woods for the sake of the wild pasture that follows in the wake of a forest fire.

149. The pine woods in South Georgia are burned to protect the turpentine boxes. If the cup and gutter system of turpentining is used there are no boxes to protect, and the main reason for burning is done away with. Even where the boxes are used the same amount of money spent

on fire lines and patrol would give protection.

150. This question of forest fires is not wholly an individual question. It is partly a community question; for the rights of many persons are involved. If an owner sets his woods afire the fire may spread to neighboring woods, or it may burn up his neighbor's fences, fodder stacks, and buildings. Fire is in a class with poisons and explosives; and if it is used, it should be used carefully and with reference to the rights of others.

151. Topics for further study;—

(a) Relation between broken places in the bark and fungous attack,

(b) Part played by birds in insect suppression,

(c) Effect of forest fires on the bases of mature trees,

(d) Effect of fires on turpentine boxes,

(e) Effect of fires on the composition of stands,

(f) Destruction of birds nests and young birds by fires.

CHAPTER IV. THINNINGS

152. Thinning is the removal of some of the trees from a stand for the benefit of the trees that remain. To understand thinning it is necessary to review the development of a stand. Suppose that a young stand is recently started, and that the trees are 6 feet apart each way, or 1210 to the acre. When the stand is about ten years old the side branches of the trees will begin to touch, the ground will be shaded; and the stand has become what the foresters call a "closed stand." As soon as the stand is closed the trees begin to crowd one another. The crowding results in the dying of the lower side limbs and in an increased height growth. Some of the trees get ahead of the others, and before many years they become separated into classes. These classes are called (1) dominant, (2) intermediate, (3) suppressed, and (4) dead. The names indicate the condition of the trees in the classes to which they are applied. By the time the stand is fifty years old probably not more than 500 out of the original 1210 trees will be alive. The others have been shaded to death by their stronger neighbors; and some of those that are still alive will succumb within a few years. If, as often occurs in natural seeding, there are several thousand trees at the start the crowding will be greater and the results will be more marked.

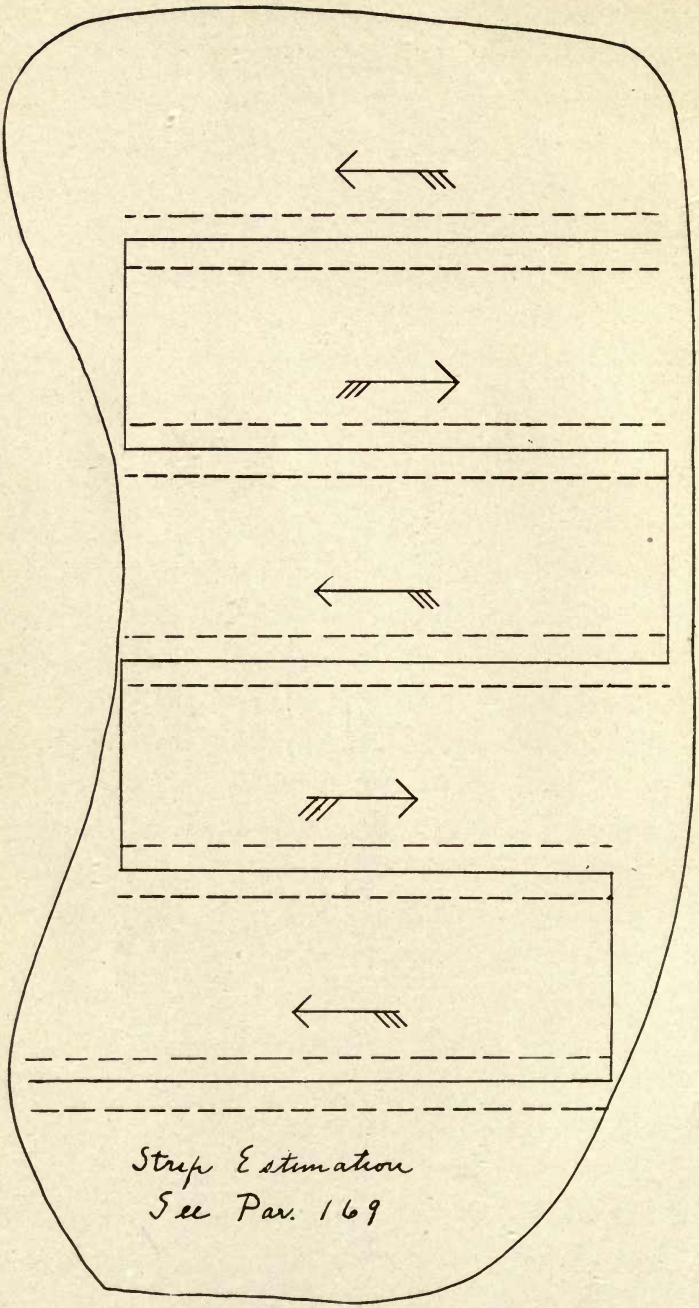
153. A moderate crowding is beneficial to the stand. It causes the trees to grow up tall and straight and to shed their side limbs. Long, clean, straight logs that saw out clear lumber are the result of crowded stands. On the other hand, the struggle in a closed stand may become too fierce; and it may react in a harmful way on the stand. The stems

may become so slender that they cannot stand upright, and the tops may become so restricted that they no longer properly perform their functions. By the removal of some of the trees the beneficial influences of the struggle may be renewed from time to time and the harmful effects may be avoided. In other words, thinning prevents the stimulative competition from becoming a destructive competition.

154. Thinnings are influenced by market conditions. If there is a market for small material, a young stand may be thinned earlier and the thinning may be repeated oftener than when there is a market for only the larger trees. **A young stand may be thinned as soon as the material to be removed has reached such a size that its sale will pay for its removal; and it should not be thinned again until the material to be removed has accumulated in sufficient quantity to yield a profit, or at least to pay for its removal.** If this rule is followed, the improvement of the stand which results from the thinning will be a net gain. In some cases a thinning might be made even at a slight expense and still be profitable in the end; but it is safer to follow the rule given above. Where it is practicable to thin in this State, the application of the rule would mean a moderate thinning when the stand is 25 or 30 years old and a repetition of it every 10 or 15 years thereafter until maturity is reached. Farmers are in a better position to practice thinning than some other classes of owners; because there is nearly always a demand on the the farm for firewood, posts, poles, and other small material. Even where there is no outside market for small material, thinnings may be practiced on the farm to the extent of the small material consumed on the farm.

155. The classes into which trees become separated in the course of their struggle with one another help to determine the trees to be removed. **A moderate thinning involves the removal of the intermediate trees that are interfering with the development of the dominant trees.** The stand should not be opened up too much. If it is opened too much and too much light is admitted, an undesirable undergrowth of grass, weeds, briers, and shrubs may result, or it may bring on reproduction before it is wanted. Kinds that are liable to windfall, like the pine, should not be heavily thinned, or windfall may occur. But while care should be taken not to thin too heavily, the stand must be opened up enough to influence its growth. The cover should be broken, but it should not be broken to such an extent that it will take more than 2 or 3 years for it to close again.

156. Whether the suppressed and dead trees should be removed depends principally on whether they contain enough wood to make their removal worth while. Some stimulation may result from the removal of the suppressed trees; but most of them are so far behind the dominant trees that their presence or absence has little effect one way or another on the development of the final stand. Yet it often pays to remove some of the suppressed and dead trees while the thinning is in progress, although it would not pay to go into the stand for the suppressed and dead trees alone, except in extraordinary cases. And, on the general principle of cleaning a stand of all the useless material which might invite disease or increase the risk from fire, it is sometimes expedient to remove dead and suppressed trees while thinning is going on and it can be done without extra cost. If, on the other hand, the cover composed of dominant and intermediate trees is not


Strip Estimation
See Par. 169

enough to keep the ground sufficiently shaded, it is sometimes advisable to keep the suppressed trees or a portion of them to shade the ground.

157. The proportion of the volume of the material removed to the volume of the stand may serve as a check in making thinnings. A moderate thinning would fall between 10 and 20 per cent of the volume of the stand. If, for example, the stand runs about 30 cords to the acre, the amount to be taken out would fall between 3 and 6 cords. If it falls below 3 cords, the indication is that the thinning is too light and that more should be taken. If it goes above 6 cords, it indicates that the thinning is too heavy and that less should be taken.

158. If the stand is composed of several kinds of trees, there may be a choice among the kinds as well as among the individuals of the same kind. The desirability of a kind depends on its market value, its usefulness on the farm, its habit of growth, and its adaptability to the soil. In thinning the more desirable kinds should be given the preference over the less desirable, when it is possible to show a preference. For example, a black jack and a white oak are standing side by side and one must be removed for the good of the stand; the black jack should be removed and the white oak should be left.

159. While thinning, strictly speaking, is the removal of some trees for the betterment of the stand, it may be combined with other work. When, for example, a stand is uneven-aged, a thinning among the younger trees may go hand in hand with harvesting the mature trees; and the cost of each operation may be reduced by both being done at one time. But for clearness of thinking the two operations

should be kept separate in mind, although they may be combined in the woods.

160. Thinnings bring important results. They lessen the danger from fungus and insect attack and from fire. By taking out the inferior kinds of trees and giving the better kinds a chance, they increase the proportion of the better kinds. By keeping the rate of growth even, they produce an even grade of lumber. By keeping up the stimulative competition they hasten the maturity of the final crop; or to put it in other words, they increase the output in a given period of time. And, by the removal of unsightly trees and increasing the thrift of the stand, they improve the appearance of the woods. This last may be of considerable importance if the grove happens to be near the farm house.

161. The influence of thinning on growth is felt the next growing season, when the trees begin to respond to the increased amount of light. It is not making an improvement that it will take a life-time to get the benefit of, as many mistakenly suppose; it is making an improvement which pays for itself and the benefit of which begins within the year.

CHAPTER V. CUTTING MATURE TIMBER

162. In general it is better to cut the mature timber, and also to thin, during the winter months; for timber cut in the winter months seasons better than timber cut in the summer; and summer cutting in pine stands increases the liability of attack by bark-beetles.

163. In felling large timber and cutting it into logs the cross-cut saw is preferable to the ax. The saw saves the ax-kerf and it saves time.

164. To cut the mature timber with reference to reproduction is not as important as in some other States. It was pointed out in Chapter 2 that the exclusion of fires is the most important factor in securing reproduction. However, it is sometimes possible to aid reproduction through the control of cutting; and when this can be done without much extra cost, it should be done. For instance, in an uneven-aged stand the mature trees may be thrown away from or to one side of the clumps of younger growth. Some breakage is unavoidable, but a little care will reduce it.

165. If the stand is even-aged it is better to cut clear than to cull. The smaller trees have been stunted, and they will not take on a thrifty growth when the larger trees are removed, and they interfere with the young sprouts and seedlings that come up under them. Seedling reproduction of an even-aged stand may be favored by cutting soon after a heavy seed-year of the kind that is most desired, or by leaving 2 or 3 trees to the acre of the most desired kind to act as seed trees.

166. The amount of timber that is cut from a forest should be regulated so that the stock in the forest will not be

exhausted. One way of regulating the cut is by area. If there are 250 acres in timber, and it takes about 60 years for the trees to reach the required size, that is, to reach maturity, then about 4 and a quarter acres could be cut over each year, or if more convenient the cut for 2 or 3 years could be made in one year; but the area cut over should average about 4 and a quarter acres a year.

167. Another way to regulate the cut is by volume. On a place in Middle Georgia the estimate shows a stock of 1,529,000 board feet, and as it takes about 60 years for the trees to reach maturity, the amount which it is safe to cut may be found by the formula;—

$$\frac{\text{Stock}}{\frac{\text{Rotation}}{2}} = \text{annual cut; or}$$

$$\frac{1{,}529{,}000}{\frac{60}{2}} = \frac{1{,}529{,}000}{30} = 50{,}966 \text{ feet.}$$

Then it would be safe to cut about 50 thousand feet a year; and if more convenient 2 or 3 years cutting, or 100,000 or 150,000, may be taken out in one year, provided that the average is not more than 50,000 a year. The stand should be estimated at intervals; and if the amount of timber is greater or less, the cut will change correspondingly. If after 10 years, the stand mentioned above is estimated again; and it is found to contain 1,200,000 feet, the cut should be reduced to 40,000; if the new estimate is 2,000,000, the cut may be increased to 66,000. It will be seen that the formula is self corrective. The chances for mistakes are in deter-

mining the time that it takes to produce trees of cutting size and in estimating the timber.

168. The age at which the trees reach the cutting size can be gotten by counting the rings on the stumps of several of the most important kinds that compose the stand. For the tract used as an illustration above where the stand is mostly loblolly pine, 60 years is long enough to allow for a rotation. In the case of longleaf pine, it would hardly be safe to allow less than 100. But it is best to consider each tract separately, with reference to local conditions of market and growth.

169. The stand in board feet may be obtained by estimating the timber on several acres, striking an average, and multiplying by the number of acres. The sample acres should be carefully chosen to insure that they represent the stand. The chances for mistakes are lessened if the sample acres are in the shape of strips. A compass line may be followed and the trees estimated for 33 feet on each side of the line. This gives a slice 66 feet wide through the timber; and when such a strip is 660 feet long, it represents an acre. A pocket compass, a surveyor's chain, a note book, and a log rule are needed for the work. The direction of the line is found by the compass, then the chain is brought along this line; the trees are estimated on each side of the chain. If there is doubt as to whether to include a tree standing near the edge of the strip, the distance, 33 feet, may be paced, Practice soon does away with the necessity of pacing unless the timber is very thick. When the trees have been estimated on both sides of the chain, the direction is found again. the chain is brought forward, and the process is repeated. When the edge of the tract is reached an offset is made and

then a strip is run back parallel to the first, as indicated on the diagram. If the long chain, 66-foot, is used, 10 chains make an acre; if the short chain, 33-foot, is used, 20 chains make an acre.

170. There are several log rules in use. Most of them were made with Northern conditions in view. The following rule has been constructed for the purpose of getting a rule adapted to the conditions found in the average small mill in Georgia. It is based on the following suppositions;—that the saw-kerf is a quarter of an inch; that the boards are an inch thick, the smallest 3 inches wide and the largest 12; and that the logs are normally sound and straight. A special allowance must be made for hollow and very crooked logs. The height to which the logs will run is estimated. A ten-foot pole set against the tree is a great help in estimating heights; for it gives a point for comparison. After a little practice the pole may be set aside. When the distance from the ground to the point where the tree ceases to be usable has been estimated and the height of the stump deducted, the trunk is divided into logs. If, for instance, the usable part of the tree is 33 feet long, it will make two 16-foot logs. The next step is to estimate the diameters of the top ends of the logs. A steel square is helpful in estimating diameters. Hold it in one hand at breast height with the tongue and blade against the tree; then a lath or straight stick held in the other hand laid against the tree parallel to the tongue will indicate the diameter on the blade. With the diameter at breastheight known, the diameter at the tops of the logs can be estimated by comparison. In a short time the eye becomes accustomed to estimating diameters without the use of the square. The rule is for diame-

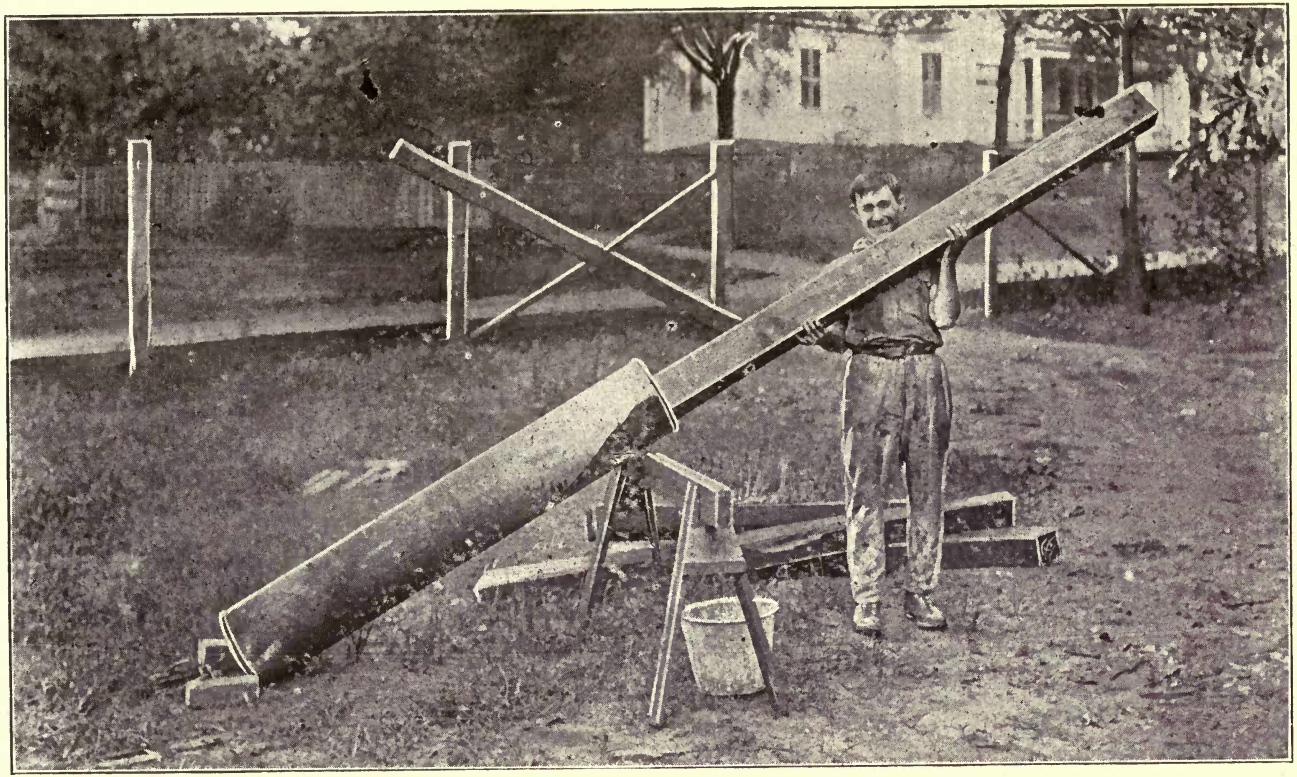


Fig. VI. Tube method of creosoting posts. Par. 186

ters inside the bark, so an allowance must be made for bark. An inch is enough allowance to make for most kinds of timber. Suppose in the case mentioned the top diameter of the first log is 15 inches and the second is 13; then they should be reduced to 14 and 12. The next step is to record the logs in a note book in any convenient form. At the end of the work in the woods the logs are scaled by the rule and the totals run up.

171. LOG RULE

Diameter in inches, inside bark, at small end.

Length in feet.	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Length in feet.
8	7	11	17	23	29	36	42	52	61	72	83	93	104	118	132	150	168	181	194	215	237	257	277	297	317	8
10	8	13	20	28	36	43	51	63	75	89	102	115	128	146	163	185	207	224	240	267	293	319	344	368	394	10
12	9	15	23	33	42	51	61	75	89	105	121	137	152	173	194	221	248	267	286	318	350	380	410	440	470	12
14	10	17	27	37	48	59	70	86	103	121	140	158	177	221	225	256	287	310	332	369	406	442	477	512	546	14
16	11	19	30	42	35	67	79	98	117	138	165	180	201	228	256	292	327	353	378	421	463	503	543	584	623	16
18	12	20	33	47	61	75	89	110	131	155	178	201	225	256	287	327	367	396	425	472	519	574	610	655	712	18
20	13	22	37	52	67	82	98	121	145	171	197	223	249	284	318	362	406	439	471	523	576	626	674	726	775	20
22	15	24	40	57	74	90	107	133	159	188	216	245	278	311	349	398	447	482	517	575	633	688	743	797	852	22
24	15	26	44	61	80	98	116	144	173	204	235	266	298	339	380	433	486	525	563	626	689	749	810	869	928	24
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	

PART II. USE OF TIMBER

172. The discussion of our timber supply falls into two main parts. One is the production of future crops, and this has been discussed in Part I. The other is the preparation and use of the crops on hand or which may be produced hereafter; Part II deals with this second division of the subject.

CHAPTER I. SAW MILLS ON THE FARM

173. There are a great many farms in Georgia with enough timber on them to make it practicable to have a saw mill on them. It is desirable to have a saw mill on the farm for several reasons. One reason is that it gives the farmer control of the operation. He can make it fit the condition of his timber. He can study his timber and cut it when it is ripe. If he has the cutting and sawing done by contract, he cannot have the same control. The work is done by men who have no permanent interest in the place, whose only interest is to get what they can out of it and go. In some cases he has to cut timber before it is ripe; and in others he has to let it deteoriate, because there is not enough of it to induce a contractor to come.

174. Another reason why it is desirable to have a saw mill on the farm is that it enables the farmer to keep his hands and stock busy when it is hard to find anything for them to do. There are many days in the year when it is wet or unseasonable for work in the fields, which can be turned to good account in the woods or at the saw mill.

175. Another reason is that it tends to build up the place. Improvements and repairs are easier to make if the

material is at hand than when it must be hauled from a distance. It is also more often possible to get the kind of timber needed and in the right sizes.

176. The small No. 0, or Pony, saw mill is sometimes recommended for farm use. It is cheap, and when properly handled does satisfactory work with small and medium logs. But the No. 1 mill can turn out more lumber in a day, is less liable to get out of order, and can handle larger logs; so that it may be cheaper in the end to get the No. 1 mill. The cost of some of the articles varies with the different dealers, some charging more for one article and less for another, but an outfit of standard make foots up nearly the same with all of the dealers. The following is about the average cost;—

No. 1 mill	$ 355
50-inch saw	75
Belts	45
Cant hooks and sundries	20
	$ 495

177. A shingle mill is a useful adjunct to the saw mill, since there is often a call for shingles to cover farm buildings. A shingle mill costs about $85.

178. The steam engine is better adapted to driving a saw mill than the gasoline engine. The load is an irregular one, and the steam engine accommodates itself more readily to an irregular load. And it is simpler and easier to run. For farm use the portable type, with engine on the boiler, is best; for the engine is needed on different parts of the farm to run gins, shredders, feed choppers, and syrup mills. A 15-horse power engine will pull a No. 1 mill satisfactorily. It costs about $850.

179. The mill and engine should have a good roof over

them. As soon as the year's sawing is done all of the parts that are likely to rust should be oiled or painted.

180. It hardly pays to put a saw mill on a farm unless there are 40,000 feet to be cut each year; or to express it in acres, unless there are about 250 acres of well stocked timber land. The writer knows a mill that is operated on a place where there are only 150 acres of timber land; but the neighbors bring in logs for custom sawing, so that really the mill is fed from a much larger area. If there is less than 40,000 feet to be cut, interest, taxes, and depreciation eat up the profits. With good management and 40,000 and over to saw, the farm mill earns a neat profit.

CHAPTER II. PRESERVATIVES

Section 1. Cause of Decay

181. At ordinary temperatures wood is a stable compound. Unless it is acted on by some outside agency it will last forever. When we speak of wood rotting we mean that it has been attacked by a fungus. The fungi have no green leaves and cannot draw their food from the soil and air as trees and other plants with green leaves do. They must feed on the tissues of other plants. It was pointed out at Paragraph 136 that the fungi sometimes feed on standing trees. They also feed on timber when it is cut.

Section 2. Conditions of Decay.

182. The fungi must have several conditions to live. First of all the organism itself must be present, either in the form of spores or fragments of a mature plant. An experiment running over many years was made by the late Professor W. H. Brewer, of Yale, which proved that wood does not rot no matter how favorable the other conditions are, provided the organism is not transplanted to it. The other conditions are air, water, heat, and food—all of which must be present in sufficient quantities or a fungus cannot live and grow after it has been transplanted. Timbers that have been buried where the air could not reach them have lasted for centuries. Timbers used in dry places do not decay; the so-called dry rot is in places where there is some moisture. Timbers kept at low temperatures do not decay; and decay is more rapid in warm climates than in cool climates. And timbers which have been poisoned and rendered unfit for food for the fungi do not decay.

Section 3. Prevention of Decay

183. Decay can be prevented by excluding one of the conditions necessary for the life of the fungi. If they can be kept from entering, or if the air or water can be excluded, or if the tissues can be poisoned, the timber can be made to last indefinitely. Most of the preservatives act in more than one way. Paints, for instance, coat the surface of the wood, and exclude the spores, air, and water, and they also contain poisonous substances. One of the best and cheapest preservatives is creosote. This, like paint, excludes the spores, air, and water; and the carbolic acid which it contains poisons the tissues of the wood.

184. Creosote is applied in different ways. One way is to heat it and apply with a brush, like paint. This is a cheap way; but it is not so effective as some of the others; because the creosote does not go deeply into the wood. But for shingles it is the most practicable; for if they are treated in some other way before they are laid, they are apt to stick together and become hard to handle and the creosote is hard on the hands of the workmen. So it is best to lay the shingles and then to apply the creosote with a brush, letting it flow freely so that it will get into the cracks.

185. Another method used mostly for treating posts, is known as the open-tank method. The posts are placed in a tank of hot creosote; and after 2 hours the hot liquid is drawn off and cold creosote is run in. The posts are left in the cold liquid for 2 hours and then removed. The heating expands the air in the posts and drives it out. When the cold liquid is turned on the pressure of the air on the outside drives the creosote into the vacua that have been created. The objection to this method is that the outfit costs about

$50; and it would not pay except on a very large farm where there is a great deal of fencing to be done.

186. A method has been devised by the writer to meet the needs of the small farmer. A simple galvanized iron tube, 10 inches across and 5 feet long, is used. It can be made by any tinner, at a cost of not more than $2. The one shown in the cuts cost $1.50. The tube is leaned against a bench or other support at a convenient slant, filled about two-thirds full of creosote; and a small fire is built against the bottom. A post is dipped into the tube and withdrawn after 3 or 4 minutes. It is placed upright with the lower end in a bucket to catch the creosote that drains off. Another post is placed in the tube, and the first is removed from the bucket and placed on the pile. The cost of treating posts for 3 feet at one end is from 2 to 3 cents. This method is not so effective as the open-tank treatment, but it is more effective than the brush treatment, and it costs less than either.

187. Timber should be seasoned before it is treated with a preservative; and it is best to let it stand for some weeks after treatment.

188. It hardly pays to treat timbers that are naturally lasting, such as heart pine, white oak, mulberry, and locust. But it does pay to treat the black oaks, loblolly pine and the like. With only a brush treatment some loblolly pine posts put in 4 years ago are still serviceable and will probably not have to be taken out for 2 more years. Loblolly pine without treatment lasts about 2 years. While definite information is hard to get, the indications are that the loblolly pine, which is cheap, easy to cut, light to handle, and easy to drive staples into, can with the tube treatment be made to last as long as white oak, which is expensive, hard to cut, heavy to handle, and hard to drive staples into.

CHAPTER III. FIREWOOD

189. Firewood should come from limbs, tops, and the trees taken out in thinnings for improvement. Trees that are large enough to make saw-logs or that give promise of growing into saw-logs should not be cut for firewood. The wood used for fuel on the farm should be so much waste saved, so much improvement made, and not a drain on the stands of timber.

190. To give the best results firewood should be cut and stacked some months before it is used. Green wood burns longer than dry wood, but a large part of the heat is spent in driving off the moisture.

191. A great deal of the wood used for fuel is burned in open fireplaces. Fireplaces have their advantages, one of which is their cheerfulness; but as a means of heating a cold room and keeping it at an even temperature they are inadequate. A large part of the heat goes up the chimney; and this means a large consumption of fuel. There is no way to regulate the heat; the room is very hot or very cold. And there is risk of setting the house afire, since the fire is not enclosed.

192. While not so cheerful, stoves consume less fuel, can be regulated, and are not as liable to set the house afire. No record of a test of the comparative efficiency of stoves and fireplaces could be found; so a test was made in the winters of 1911 and 1912. Wood was weighed out in equal piles. The piles were burned alternately in the fireplace and in the stove. In order to have the conditions the same, the same room was used; the fireplace was closed on alternate days and the stove set up. The tests were carried on for 10 days,

so that variations of weather would be evened off as far as possible. Thermometers were hung in the middle of the room, near the wall farthest away from the chimney, and on the outside of the house. The comparison was made by recording the time that the temperature at the middle of the room was kept above 65 degrees Fahrenheit. These tests showed that the wood burned in the stove kept the room above 65 degrees a little more than 13 times as long as the wood burned in the open fireplace. With the same conditions one cord of wood burned in a stove goes as far as 13 cords burned in an open fire-place. On some of the coldest days when the warmth was needed most, the fireplace never raised the temperature to 65 degrees.

193. The stove used was of the sheet-iron type. These are easily fed and easily regulated. The large sizes cost about $5.50, including pipe and floor mat. The writer has some that have been in use for 6 years; and they can be counted on to last for at least five years if oiled each spring. Rusting during the summer months is harder on them than use during the winter. If a stove is in a room where a fire is kept going steadily, it soon pays for itself and then effects a considerable saving.

194. There is a belief that stoves are not as healthful as fireplaces. Enquiries were made of physicians. They were of the opinion that stoves are as healthful as fireplaces, provided ventilation is secured. In some respects they are more healthful, for they consume less oxygen to produce a given amount of heat and they keep the room at an evener temperature and this is of considerable importance, especially where there are small children.

PART III. PLACE OF WOODLANDS IN FARM MANAGEMENT

195. The length of time that it takes to grow a crop of timber keeps many owners from practicing forestry. Although they consider timber a profitable crop, they think of the harvest as too far in the future to be of any interest to them. This attitude comes from looking at only one side of the question. It is true that it takes a long time, in some cases more than a hundred years, to grow a crop of timber; but it is also true that the average owner does not have to start with the bare ground; he starts with a stand of timber, some of which is mature and ready for the market; and with very little or no curtailment of his immediate profits, he can improve his stand so as to increase future profits. The conditions are like those in a store that is partly stocked. The store-keeper may improve the quality of his stock and increase its size and continue to sell goods in the meantime.

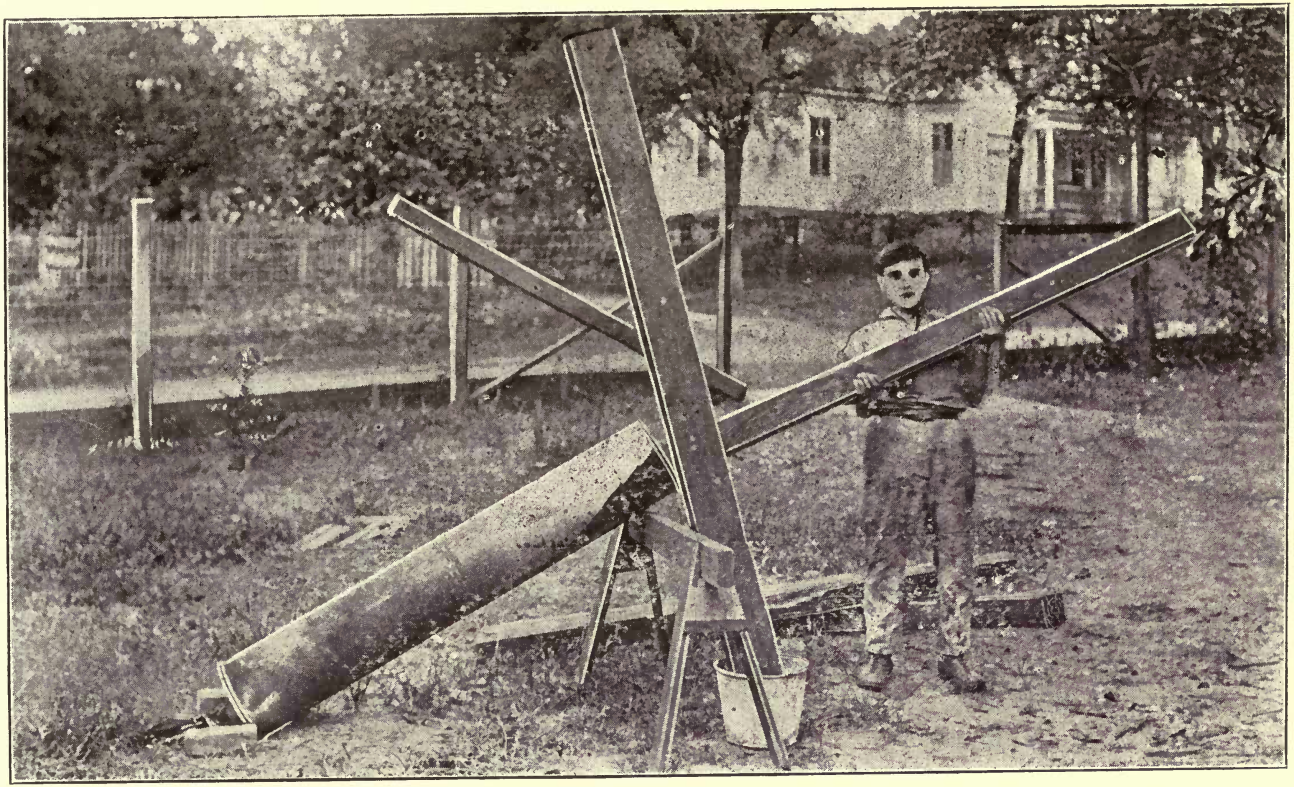
196. The timber crop has its place in farm management. Nearly every farmer needs lumber for bridges, fences, cribs, and barns, and cord wood for fuel. If he produces this material on the farm, he not only saves himself the inconvenience and expense of bringing it from a distance, but he makes the profit involved in its production.

197. There is a great deal of complaint about the scarcity of labor on the farm. Indeed there is a movement to import foreign laborers into some of the Southern States. Such a movement can give only temporary relief. The final solution must be sought for in other directions, and one of these is provision for employment throughout the year. Steady employment is one of the first conditions of getting

together and of keeping together a force of dependable laborers. Timber lands on a farm, especially if in connection with a saw-mill, furnish employment when work in the fields is at a standstill. There is least to do in the fields in the winter and this is the best time to work in the woods; so that one fits into the other. In this way timberlands are of importance in farm management, not only because of the material which they produce, but because they furnish a means of keeping labor ready for work in the fields when a perishable crop must be moved quickly or be lost.

198. According to the Federal census there are 26,392,000 acres in Georgia farm holdings. Of this area only 10,615,000 acres are reported to be in field crops. This leaves 15,777,000 acres in woodland and waste. There is very little waste land; and most of what is called waste is capable of producing timber crops. More than one-half of the average farm in Georgia is covered by woods; and since the settlement by our people has been going on for 182 years and clearing has progressed no further than it has, it is not likely that the wooded area will be greatly reduced for several generations. The owners must pay taxes on this land and they are out the interest on the investment. It is clearly to their advantage to make this land as productive as the conditions will permit. The practice of forestry is the means to this end.

199. While the main effort of the farmer should be expended on his field crops and live stock, some part of it may be profitably expended on his woodlands. Their place in farm management is that of a useful adjunct to the farm.



INDEX

Absorption ..... Par. 9
Anchorage 9
Annual layers 3
Ash, green 102
Ash, red 102
Ash, water 102
Ash, white 102

Bark beetles 139
Basswood 91
Beech 50
Branches, function of 3
Branches and knots 3
Catalpa, hardy 103
Catalpa, common 104
Checklist, Sudworth's 108
Cherry, black 78
Chestnut 53
Clear cutting 165
Coastal plain 12
Cottonwood 47, 115
Creosote 183, 184, 185, 186
Cuttings 115
Cypress, bald 30

Decay 181, 182, 183
Dominant trees 152

Estimate of stand 169
Eucalypts 107

Fire 142

Fire lines 147
Fireplaces 191
Firewood 189, 190
Foliage, extent of 8
Foliage, function of 4
Fungi, ... 136

Gum, black 94
Gum, sweet 72

Hickory, bitternut 42
Hickory, mockernut 39
Hickory, pecan 43
Hickory, pignut 42
Hickory, shagbark 42
Hickory, shellbark 42
Improvement thinnings 152
Insects 138
Intermediate trees 152

Juniper, red 33

Knots, formation of 3

Labor 197
Leaves, arrangement of 7
Locust, honey 81
Locust, yellow 84
Lime, Ogeechee 96
Log rule 171

Maple, red 87
Mature timber 162
Mockernut 39

Mountains 12
Mulberry, red 66

Oak, chestnut 61
Oak, cow 61
Oak, live 61
Oak, post 61
Oak, red 62
Oak, scarlet 65
Oak, Spanish 65
Oak, water 65
Oak, white 58
Oak, willow 65
Oak, yellow 65

Pecan 43
Persimmon 99
Piedmont plateau 12
Pine bark beetle 139
Pine, Cuban 20
Pine, loblolly 23
Pine, longleaf 17
Pine, shortleaf 26
Poplar, yellow 71
Preservatives 181, 182, 183
Protection 135

Regulation of cut 166, 167
Reproduction 110, 111, 115, 116
Respiration 9
Roots, functions of 2
Root-hairs 2
Rootlets 2

Sargent's Manual ---- 108
Saw-mills ---- 173, 174, 175, 176
Seed ---- 116
Seed-bed ---- 127
Seed-spots ---- 122
Sprouts ---- 111
Steam engine ---- 178
Stem, function of ---- 3
Stoves ---- 192, 193
Strip estimation ---- 169
Sudworth's Checklist ---- 13, 108
Suppressed trees ---- 152

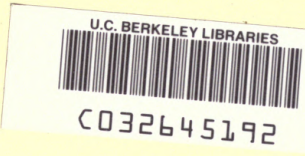
Thinnings ---- 152
Transpiration ---- 9
Tube method of creosoting ---- 186
Tulip-tree ---- 69
Tupelo ---- 96

Use of timber ---- 172

Walnut, black ---- 36
Willow, black ---- 44, 115

To be had of the author at Greensboro, Georgia. The price with paper backs is 60 cents, bound in board 80 cents.

ekc net
ls



SJ373
A32
328404
Akerman
UNIVERSITY OF CALIFORNIA LIBRARY